इंटरनेट मानक

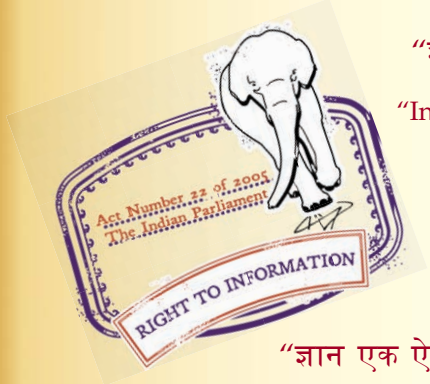
Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 4051 (1967): Code of practice for installation and maintenance of electrical equipment in mines [ETD 22: Electrical Apparatus for Explosive Atmosphere]



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

IS : 4051 - 1967
(Reaffirmed 1996)

Indian Standard

CODE OF PRACTICE FOR INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT IN MINES

Fourth Reprint JUNE 1999
(Incorporating Amendment No. 1)

UDC 621.3.005 : 622.4

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 5 *June* 1967

Indian Standard

CODE OF PRACTICE FOR INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT IN MINES

Flameproof Electrical Equipment Sectional Committee, ETDC 22

Chairman	*Representing*
SHRI S. S. KUMAR	In personal capacity (6, *Purana Quila Road, New Delhi*)
Members	
DR G. N. BADAMI	Central Mining Research Station (CSIR), Dhanbad
MAJ V. BALAKRISHNAN	Scientific Adviser, Research & Development Organization (Ministry of Defence)
MAJ J. P. THAPLIYAL (*Alternate*)	
SHRI A. G. BARVE	Esso Standard Eastern, Inc, Bombay
SHRI P. K. BHARUCHA	The Insurance Association of India, Bombay
SHRI A. C. MODY (*Alternate*)	
SHRI S. R. BHISE	Directorate General of Factory Advice Service & Labour Institutes (Ministry of Labour, Employment & Rehabilitation), Bombay
SHRI S. CHANDRA	Kilburn & Co Private Ltd, Calcutta
SHRI K. K. RAY (*Alternate*)	
SHRI N. GHOSH	Chief Inspector of Mines (Ministry of Labour, Employment & Rehabilitation), Dhanbad
SHRI R. E. GLOVER	Indian Mining Association, Calcutta
SHRI P. MORAN (*Alternate*)	
SHRI D. P. GUPTA	Directorate General of Technical Development (Ministry of Supply, Technical Development & Materials Planning), New Delhi
SHRI K. V. KRISHNAMURTHY	Heavy Electricals (India) Ltd, Bhopal
SHRI S. N. LAHIRI	Chief Inspector of Explosives, Nagpur
SHRI S. C. ROY (*Alternate*)	
SHRI T. K. MISRA	The Association of Mining, Electrical & Mechanical Engineers, UK, Indian Sub-Branch, Calcutta
SHRI J. SUBRAMANYAN (*Alternate*)	
SHRI V. B. K. MURTHY	National Coal Development Corporation Ltd, Ranchi

(*Continued on page* 2)

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

(*Continued from page* 1)

Members	*Representing*
SHRI D. P. PATEL	Indian Electrical Manufacturers' Association, Calcutta
SHRI C. P. DUSAD (*Alternate*)	
SHRI F. N. PRANGNELL	A. Reyrolle & Co Ltd, Calcutta
SHRI H. S. BHATIA (*Alternate*)	
SHRI S. G. RAMACHANDRA	Kirloskar Electric Co Ltd, Bangalore
SHRI V. SUBRAMANYAM (*Alternate*)	
SHRI P. N. RAMACHANDRAN	Hindustan Brown Boveri Ltd, Bombay
SHRI V. D. ERANDE (*Alternate*)	
SHRI C. K. V. RAO	Central Water & Power Commission (Power Wing)
SHRI L. C. JAIN (*Alternate*)	
SHRI V. M. RUPERALIA	Indian Colliery Owners' Association, Dhanbad
SHRI ZAUNER	NGEF Ltd, Bangalore
SHRI T. APPASWAMY (*Alternate*)	
SHRI J. S. ZAVERI	Bharat Bijlee Ltd, Bombay
SHRI C. E. BHASKAR RAO (*Alternate*)	
SHRI Y. S. VENKATESWARAN, Director (Elec tech) (*Secretary*)	Director General, ISI (*Ex-officio Member*)

Panel for Code of Practice for Installation and Maintenance of Flameproof and Intrinsically Safe Electrical Equipment, ETDC 22 : P3

Convener	
SHRI V. B. K. MURTHY	National Coal Development Corporation Ltd, Ranchi
Members	
DR G. N. BADAMI	Central Mining Research Station (CSIR), Dhanbad
SHRI S. RAMANATHAN (*Alternate*)	
SHRI N. GHOSH	Chief Inspector of Mines (Ministry of Labour, Employment & Rehabilitation), Dhanbad
SHRI R. E. GLOVER	Indian Mining Association, Calcutta
SHRI T. K. MISRA	Bharat Bijlee Ltd, Bombay
SHRI C K. V. RAO	Central Water & Power Commission (Power Wing)
SHRI L. C. JAIN (*Alternate*)	
SHRI J. SUBRAMANYAN	The Association of Mining Electrical & Mechanical Engineers, UK, Indian Sub-Branch, Calcutta

Indian Standard

CODE OF PRACTICE FOR INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT IN MINES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 5 April 1967, after the draft finalized by the Flameproof Electrical Equipment Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 With the extensive development of the mining industry in recent years with greater emphasis on mechanization leading to wider use of electricity, the need to establish a sound code of practice for the installation and maintenance of electrical equipment in mines is strongly felt. Further, the continued safety of flameproof and intrinsically safe equipment in explosive atmosphere is as much dependent on installation and maintenance as it is on the design.

0.3 The environment and conditions in mines, in general, demand special attention and care during the installation and maintenance of electrical equipment. Lack of proper working space, poor lighting conditions and the frequent shifting of equipment are some of the factors which have to be taken into consideration while planning an installation and maintaining it inside a mine. This code details the general rules to be adopted in all mines in addition to precautions to be exercised specially in gassy coal mines.

0.4 This code deals essentially with the general aspects of installation and maintenance of electrical equipment in mines and does not cover details of any particular equipment.

0.5 While preparing this code, considerable assistance has been derived from similar rules and codes prepared in other countries. This code has particularly taken into consideration the recommendations of the International Labour Organization contained in the book 'Prevention of accident due to electricity underground in coal mines' and the codes laid down by the National Coal Board of the United Kingdom.

0.6 The various Indian Standard codes listed on fourth cover page, provide in a convenient form a record of those matters which experience

has shown to be of importance in keeping electrical equipment, in general, in good working condition. The relevant codes should be consulted for general guidance in regard to particular electrical equipment. This code details the additional precautions to be exercised in the maintenance of electrical equipment installed in mines.

0.7 The essential principle of flameproof enclosure is that the hazardous atmosphere is not excluded from the electrical apparatus, and it is recognized that an explosion may occur inside the enclosure, but the enclosure is sufficiently strong to withstand an internal explosion and is so constructed that flame passing from inside to the outside is cooled to such an extent that it is incapable of igniting the surrounding hazardous atomosphere. This is achieved by controlling the lengths of the possible flamepaths and the clearance in them.

0.8 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

---

1. SCOPE

1.1 This code covers minimum requirements for all electrical work and electrical equipment operating or intended to operate at all voltages in electrical installations in mines and quarries.

1.2 The requirements of this code apply to all types of mines unless otherwise specified.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Electrical Equipment — Any accessories, appliance or fitting, cables, etc, used or intended for use as a part of or in conjunction with an electrical installation.

2.2 Flameproof Enclosure — An enclosure for electrical machinery or apparatus that shall withstand, when the covers or other access doors are properly secured, an internal explosion of the flammable gas or vapour which may enter or which may originate inside the enclosure, without suffering damage and without communicating the internal flammation

*Rules for rounding off numerical values (*revised*).

(or explosion) to the external flammable gas or vapour for use in which it is designed, through any joints or other structural openings in the enclosure (*see also* **0.7**).

NOTE — The term 'flameproof' as used here is synonymous with the term explosion-proof ' as used in the USA or ' pressure-proof type of protection ' used in Germany for the class of apparatus covered.

2.3 Intrinsically Safe Circuit — denotes that any sparking that may occur therein in normal working is incapable of causing an explosion of the prescribed flammable gas or vapour.

2.4 Intrinsically Safe Equipment — denotes that it is so constructed that when connected and used under prescribed conditions any sparking that may occur therein is incapable of causing an explosion of the prescribed flammable gas or vapour.

3. EXCHANGE OF INFORMATION

3.1 Before ordering the electrical equipment, information regarding the duties, location and installation conditions under which they would operate, should be gathered by the engineers responsible for their procurement, installation and maintenance so that the electrical equipment or apparatus is procured to suit these conditions.

3.2 Further, before any electrical equipment is introduced into an area likely to be dangerous, full consultation should take place between those persons familiar with the nature and extent of the anticipated risk, and the electrical engineer responsible for the proposed installation, so that the necessity for special measures may be decided.

4. GENERAL REQUIREMENTS

4.1 All electrical equipment should be installed and maintained as to prevent, as far as possible, electric shock and occurrence of fire and explosion.

4.2 All materials, appliances and components used in the installation should conform to the appropriate Indian Standards. Where there are no appropriate standards, the material shall be of such quality and type as not to impair the safety of the installation.

4.3 All electrical installations shall comply with the requirements of the Indian Electricity Act, Indian Mines Act and Rules in general and Chapter X of the Indian Electricity Rules in particular and regulations made thereunder, that may be applicable.

4.4 It is recommended that the authorities concerned with the administration of the rules and regulations in the matter of the layout of the installation of electrical equipment in mines, should be consulted in regard

to the rules and regulations that may be applicable. Attention is invited to the provision in Rule 111 of the Indian Electricity Rules, 1956 (as modified up-to-date) wherein it has been made obligatory on the part of the owner of a mine or his agent to give written notice of the installation of any mining electrical equipment to the authority having jurisdiction.

4.5 Electrical installation and maintenance shall be carried out only by authorized persons competent to undertake such work under the rules and regulations that may be in force.

5. DESIGN

5.1 General

5.1.1 Only electrical equipment and instruments suitable for mine service should be used in mines. In locations in gassy mines where use of such equipment is mandatory, only flameproof and intrinsically safe equipment designed and approved for mine service shall be used.

5.1.2 In this code, the governing assumption is that it is the responsibility of the user to assess the risk in any specific condition and to take the necessary precautions.

5.1.3 Where a choice lies between electrical equipment containing flammable insulating oil and equipment of the oil-free type or of a type containing non-flammable cooling fluid, it is preferable to adopt one of the latter types.

5.1.4 Since flameproof equipment is normally designed for use in reasonably dry atmospheric conditions, special precautions should be taken to prevent any deleterious effects of moisture on the equipment where extremely damp and humid conditions prevail.

5.2 Layout

5.2.1 Due to the conditions of operation of electrical equipment inside mines, special care has to be taken to ensure that they are placed well clear of roadway traffic, protected from dripping water and collapsing roof and sides.

5.2.2 Adequate space should be provided around apparatus to allow proper facilities for maintenance purposes.

5.2.3 All rooms designed to accommodate electrical equipment, for example, sub-stations, haulage rooms, should be lined with fireproof material.

5.2.4 Meticulous care is required in the design of such housings in regard to freedom from dampness and water penetration, proper ventilation, exits and passageways to suit the equipment position.

5.2.5 No flammable or explosive material shall be stored in any room, compartment or box containing any electrical apparatus in a mine or below ground in the vicinity of any electrical apparatus.

5.3 Electrical Protection of Circuits and Apparatus

5.3.1 *General*

5.3.1.1 All circuits and equipment should be suitably protected against the effects of overcurrent and short-circuit. Earth-leakage protection should also be provided, wherever necessary.

5.3.1.2 It is recommended that the installation should be sectionalized to the utmost practicable extent to ensure selective clearance faults.

5.3.1.3 Where necessary electrical equipment shall be provided with devices which will cause the electrical circuit thereto to be disconnected in the event of failure of voltage in such circuits.

5.3.2 *Protection Against Overcurrents*

5.3.2.1 Every circuit should be provided with overcurrent protective devices so that when the current exceeds the permissible limits it shall be cut off automatically.

5.3.2.2 Automatic overload protection devices should be so designed as to follow sufficiently closely the permissible overload characteristics of the apparatus or circuit to be protected, to ensure that the supply of electricity is cut off before the parts reach a dangerous temperature.

5.3.2.3 Particular care should be taken to ensure that the thermal overload protective device, where provided, does not itself get damaged by the action of the short-circuit. The manufacturers' recommendations for maximum permissible size of fuse or maximum setting of short-circuit release should be followed.

5.3.2.4 In case of any short-circuit, the supply of electricity shall be cut off automatically by means of automatic circuit-breaker or fuses of adequate rupturing capacity.

5.3.2.5 Circuit-breakers provided with short-circuit protective devices shall preferably be of the locked-out type. This is, however, not necessary if the circuit-breaker is accessible to only authorized persons.

5.3.3 *Protection Against Earth-Leakage*

5.3.3.1 Earth-leakage protection is very essential to minimize the risk of fire, explosion and shock.

5.3.3.2 Earth-leakage protection shall be provided in all incoming circuits to portable and transportable machinery and also in other feeders wherever necessary.

5.3.3.3 Earth-leakage protection shall disconnect a circuit instantaneously before the leakage current exceeds 5 amperes unless otherwise agreed.

NOTE — Presently, sensitive earth-leakage protection device has been developed which would permit tripping at much lower value of leakage current and it should be endeavoured to use a setting as low as possible.

5.3.3.4 In an ungrounded system also, earthfault protection shall be applied as rigorously as in the grounded system.

5.3.3.5 Earth-leakage protective device shall be such that its operation may be tested periodically.

5.3.3.6 Circuit-breakers employed for providing earth-leakage protection should be provided with a locking device to prevent reclosing. In addition, the resetting device should only be operated by means of a special key which should be with the authorised electrician.

In the event of the circuit-breaker tripping on account of a fault, the electrician should not reclose the breaker unless the fault causing the tripping has been repaired or isolated.

6. PROTECTIVE MEASURES AGAINST RISK OF ELECTRIC SHOCK

6.1 Precaution Against Contact with Live Parts

6.1.1 All exposed live parts, shall be suitably guarded against accidental contact, unless the nature of the work requires them to be bare, for example, trolley wires.

6.1.2 Housing and protective enclosures shall be mechanically strong. Protective enclosures shall be of a type which need special tools for opening. Screens of close mesh type with reasonable clearance from the live parts where allowed to be used in apparatus shall be accessible only to authorised personnel.

6.2 Insulation Resistance

6.2.1 All live parts shall be adequately insulated in relation to the voltage stress to which they are liable to be exposed under fault conditions.

6.2.2 All insulating materials, which are liable to deteriorate if exposed to the atmosphere or by ingress of moisture, shall be effectively sealed so as to prevent diminution of insulating properties.

6.2.3 For recommendations regarding values of insulation resistance, reference shall be made to the relevant Indian Standard codes for various equipment (*see* 4th cover page).

6.3 Protective Earthing

6.3.1 All metallic parts not specially insulated from earth of the electrical equipment and not designed to carry current in normal operation shall be effectively and securely connected to the earth.

6.3.2 Earthing shall be effected by one or more of the following:

a) Conductive sheath where provided;

b) Armour of cables;

c) Conductive sheath and armour of cable when both are provided;

d) Special conductors forming parts of cables;

e) External earthing conductor which shall be easily visible; and

f) Conduits, casing and pipes.

6.3.3 The conductivity of the bonding conductor for earthing any particular apparatus shall be equivalent to at least 50 percent of that of the largest conductor used solely to supply the equipment subject to minimum of equivalent conductivity of copper section of 16 mm^2

6.3.4 The connection of the earthing system to the earth shall be done at the surface of the mines. The design of the earthing system at the surface shall conform to IS : 3043-1966*

7. INTRINSICALLY SAFE APPARATUS AND CIRCUITS

7.1 Intrinsically safe apparatus and circuits are so designed and constructed that for any sparking, that may occur under service condition in the apparatus or the circuit, is incapable of causing ignition of the prescribed flammable gas or vapour. Obviously intrinsic safety may only be achieved in very low power circuits like telephones, signalling remote control and interlock circuits.

7.2 An intrinsically safe circuit is characterised mainly by a low power low voltage (usually up to 24 volts dc or 15 volts rms ac) source with or without devices for absorbing the spark energy. These vary widely with different types and manufacturers and include copper sleeves, short-circuited secondary windings, non-inductive resistances, condensers and rectifiers. It is essential that the engineer-in-charge of installation and maintenance of electrical equipment in mines should be thoroughly familiar with the type of apparatus and the devices used to secure its intrinsic safety.

*Code of practice for earthing.

7.3 Intrinsically safe apparatus and circuits should be used in the form in which they are certified, as any alteration may vitiate the property of intrinsic safety. Care should be taken when replacing parts that have been damaged or otherwise rendered unserviceable to ensure that the replacements are of ratings identical to those approved.

NOTE — Special attention is invited to the possibility of nullification of intrinsic safety due to changes in design values of devices used to obtain intrinsic safety by coiling of external cables forming part of such circuits. Coiling may introduce hazards and, therefore, the cables should be laid out straight.

7.4 Adequate precaution shall be taken to prevent contact between the conductors of intrinsically safe circuits and those of any other system, so as to avoid possibility of arcing occurring at the point of contact, or of invasion of the intrinsically safe circuits by currents arising from direct or indirect contact or induction. Care should be taken to prevent contact of conductors of intrinsically safe circuits with ground pipe lines and other objects like props, cogs, etc.

7.5 Apparatus which is not intrinsically safe shall on no account be connected in the same circuit with intrinsically safe apparatus. However, use of certified coupling devices for intercommunication between intrinsically safe telephone circuits and other non-intrinsically safe telephone systems is recognized.

8. INSTALLATION

8.1 A set of record plans and technical documentation covering the information listed below shall be kept at each mine and it is necessary that such documents are kept up-to-date. The requirements of the Indian Electricity Rules under Rule 112 shall be taken care of when preparing such plans:

a) Layout diagram;

b) Type and position of all fixed electrical equipment;

c) Routes, length and cross section of all fixed power feeders and branch feeder;

d) Rating of all electrical plant and equipment;

e) Setting of overload relay and rating of fuses;

f) Calculated short-circuit currents at various remote points;

g) Method of installation of main earthing arrangements; and

h) The direction of ventilation in underground workings.

8.2 Location of Equipment with Flammable Liquids

8.2.1 Dry type electric equipment are preferred for use in mines. Wherever use of apparatus containing large quantity of flammable

dielectric liquid cannot be avoided, means shall be provided to minimize danger from fire in the event of overflow or leakage of the liquid, and arrangements should be made to prevent any such flammable liquid gaining access to any other part of the mine other than the room or compartment in which the equipment is located or to the soak pit specifically made for this purpose.

8.2.2 Suitable fire-fighting equipment shall be kept immediately adjacent to the room or compartment.

8.2.3 Soak pits and drainage channels of fireproof construction of adequate capacity and filled with clean washed pebbles or ballast to collect any liquid which may leak or may be released under fault conditions from the equipment shall be provided in or around such compartments. The design of the floor and the drainage channel shall be such that the oil is able to run readily into the soak pit.

8.3 Operating Temperatures — The equipment should be so installed, operated and maintained as to ensure that in no part the permissible maximum temperature is exceeded.

8.4 Portable and Transportable Apparatus

8.4.1 Portable and transportable apparatus shall be controlled by an approved protective switchgear. Such equipment shall be provided with means whereby they may be made dead at any time from the operator's (attendant's) position. This clause does not, however, apply to hand-lamps.

8.4.2 Connections to portable and transportable apparatus shall be by bolted or restrained type plug and socket outlets. In coal mines, for flameproof portable and transportable apparatus, the plug and socket shall be of certified and approved type. In the restrained type of cable coupler, the interlocking circuit shall be intrinsically safe.

Use of direct entry type terminations shall not be adopted without the express approval of the competent authority. Where such terminations are provided in portable or transportable apparatus due to space considerations in design, sealing material used shall be of a type which shall not alter the flameproof properties of the enclosure. Special attention shall be paid in the fitting of packing glands for compliance with the minimum length of flamepath with the packing material compressed.

8.4.3 Portable electric hand-lamps shall, where practicable, be arranged for operation at a voltage less than 30 volts, the supply being given by a double-wound transformer. Hand-lamps shall be equipped with an insulated handle and strong cover of glass or other transparent material and shall be provided with a strong guard over the cover.

8.5 Cables

8.5.1 Cables used for underground working in mines shall be of copper conductor and of the type suitable for the purpose and location.

The preferred basic types of cables and their permissible range of application have been enumerated in Appendix A. The decision as regards the use of other cables and changes in their application rests with the inspecting authorities. The appendix does not include those conventional types of cables which will be installed on the surface.

8.5.2 Cables laid in mines shall be suspended freely from metal or wooden supports with provision for normal sagging. They shall be so installed as to ensure maximum protection against mechanical damage from causes such as dangerous sagging due to their own weight, traffic and vibration. The run of cables shall be avoided in haulage roadways as far as possible.

8.5.3 In mines, only in exceptional cases, cables shall be laid in ducts of fireproof constructions which provide effective protection against mechanical damage subject to the approval of the competent authority.

8.5.4 Cables which pass through brick walls shall not be embedded or concreted at such points.

8.5.5 At terminations and joints, conductors shall be firmly secured and terminated or connected together. At terminations only locked or bolted terminals shall be used.

8.5.6 Terminals or jointing part shall be at least equivalent to the cables as regards conductivity and insulation. It shall not be possible for the conductor to be damaged by terminal and jointing parts.

8.5.7 All cable ends shall be effectively sealed to prevent diminution of its insulating properties.

8.5.8 Where paper insulated cables run vertically, for instance shaft cables, and where the temperature is likely to be high, precautions shall be taken to guard against the troubles which may arise due to bleeding of the oil compound from the cable ends. Cables for such situations shall be specified in particular at the time of procurement.

8.5.9 Provision shall be made so that the cores of the cable may be efficiently sealed to prevent moisture percolating down the strands of the cable conductors. If the conductors are taken direct through insulators to the outside of the sealing box or where separate

bare stranded conductors are connected to the cable cores (*see* Fig. 1), the conductors should be sweated solid from a point well below the level of the compound in the sealing box to a point at least 13 mm outside the insulator.

NOTE — Where sweating is not permitted, some other means of jointing should be adopted.

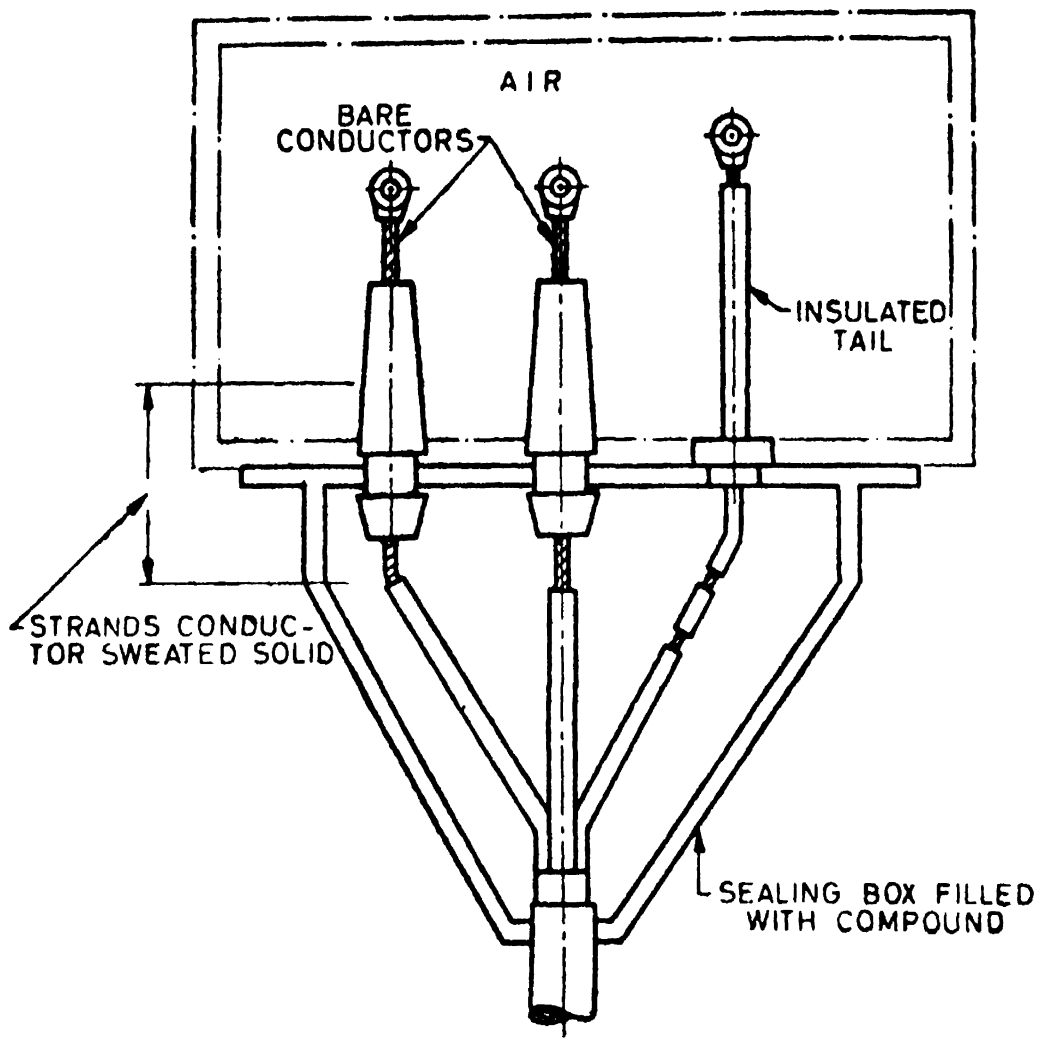


FIG. 1 METHOD OF TERMINATING CABLE TAILS

8.6 Communication and Signalling Systems

8.6.1 *Voice Communication*

8.6.1.1 Telephone communication shall be provided for all working districts, at main haulage stations, pit bottoms, underground sub-stations, central surface substation and all other essential service facilities including the dispatching station.

8.6.1.2 Circuits between stations of a communication system installed in a gassy mine, where flameproof equipment is required, shall be intrinsically safe and covered by a certificate from the appropriate authorities.

8.6.1.3 No communication system using a ground-return circuit shall be permitted in any mine.

8.6.1.4 Voice communication (with the exception of radio and carrier system) system voltage shall not exceed 50 volts in mines.

8.6.1.5 Suitable surge arresting equipment, properly grounded, shall be provided at the points where telephone circuits enter the mine.

8.6.1.6 No apparatus which is not of approved type shall be connected to a circuit in which apparatus of an approved type is required to be used, except that an underground telephone system of the intrinsically safe type may be connected at surface to another system which is not approved as intrinsically safe through the medium of a certified intrinsically coupling unit.

8.6.2 *Signalling System*

8.6.2.1 Where electrical signalling is used, the voltage used in any one circuit shall not exceed 30 V peak ac.

8.6.2.2 Apparatus used for signal purposes in mines shall be of approved type designed for protection against moisture and mechanical injury. In gassy mines, the circuits adopted for the system shall be with features of intrinsic safety.

8.6.2.3 The construction of contact-makers, such as signal switches shall be such as to prevent the accidental closing of the circuit.

8.6.3 *Conductors*

8.6.3.1 Cables for communication and signalling circuits underground shall be of the types outlined in Appendix A. Lead sheathed and wire or strip armoured cables with thermoplastic or paper insulated conductors are preferred for permanent installations. Rubber insulated pliable armoured cables are preferred to be used for the distribution circuits, which are likely to be exposed to mechanical injury and also to be shifted occasionally.

8.6.3.2 Bare conductors for signalling lines may be used if the circuit employed is certified as intrinsically safe and the conductors are installed at a safe distance (0·3 m) from power cables.

8.6.3.3 Where power cables or apparatus are installed, conductors and cables shall be installed on opposite sides of roadways or haulage roads, if practicable.

9. COMMISSIONING

9.1 Reference is invited to the various Indian Standard codes (*see* 4th cover page) for different electrical equipment which set out the inspection and test schedules before commissioning.

9.2 Before a flameproof apparatus is put into services, a close inspection shall be made for the presence of flaws or cracks and all joints shall be inspected for tightness; in the case of flanged joints, the gaps shall be checked to ascertain that they do not exceed the permitted gap dimensions.

10. MAINTENANCE

10.1 General

10.1.1 Only a regular and organized scheme of maintenance work, planned to cover all its details, may ensure continued satisfactory operation of electrical equipment with a minimum of liability to faults or to the dangers resulting from general neglect.

10.1.2 Proper and systematic organization of maintenance work, planned after completing a review of the entire electrical system and based upon time-tables intended to cover the required maintenance operations, is an essential preliminary to a good maintenance scheme.

10.2 Safety of Personnel

10.2.1 All electrical equipment shall be regarded as capable of giving rise to danger. Access to parts which may be live should, therefore, normally be prevented preferably by physical means of protective enclosures. To avoid danger, such equipment shall be accessible only to authorized persons.

10.2.2 Simple code-of-safety rules such as the 'permit-to-work' system are essential when undertaking maintenance work.

Where such arrangements are not possible some other suitable measure shall be taken to prevent energizing the conductor by any person other than the man incharge of the particular maintenance work.

NOTE — The necessity for carrying out of maintenance work under a 'permit-to-work' system is now well established. The 'permit-to-work' certificate from the engineer-in-charge of the operation to the supervisor incharge of the men selected to carry out any particular work ensures that the portion of the installation on which the work is to be carried out is rendered dead and safe for working.

10.2.3 To ensure that the equipment is dead before work commences and also they remain so effectively, even if a circuit supplying them is

inadvertently restored the power conductors shall be first discharged and then connected to the earth till such time as the maintenance work is in progress.

10.3 Safety of Equipment

10.3.1 Many of the features, which contribute to the safety of electrical equipment, are inherent in the original design. A clear appreciation of the various risks involved may enable the maintenance staff to initiate steps which might prove to be of great value in preventing the damage that a fault might cause.

10.3.2 The presence of moisture also constitutes potential danger to electrical apparatus. If an equipment is damp or if normal temperature variation results in condensation, steps should be taken to correct this condition.

10.4 Maintenance of Electrical Equipment in Mines

10.4.1 The equipment shall as far as possible be kept free from dirt and dust which, in course of time, are likely to impair the safety of the equipment.

10.4.2 Manufacturers' instruction books which detail the special attention required during maintenance of a particular equipment along with the Indian Standard codes for guidance in regard to maintenance of electrical equipment, in general should be available to maintenance staff in each mine.

10.4.3 Every flexible cable attached to a portable or transportable machine shall be examined periodically by the person authorized to operate the machine. If such cable is used underground, it shall be examined at least once in each shift by the authorized person. A damaged or defective cable should be immediately replaced by a cable in good condition. Such periodic examinations by the operator shall be supplemented by thorough examination by the authorized maintenance staff at weekly intervals. These examinations shall be as detailed as practicable and cover all accessible parts of the cable, such as the plug and the socket assembly at switch and machine end, surface of the cable and any couplers used.

10.5 Special Precautions for Maintenance of Flameproof Equipment

10.5.1 Details of design considerations of such safe apparatus are given in IS : 2148-1962*. The supervisor-in-charge of maintenance of this apparatus shall have thorough knowledge about the basic principles of their design so as to have a clearer insight into the problem

*Specification for flameproof enclosures of electrical apparatus. (since revised).

of maintenance of such apparatus. For the purpose of guiding the maintenance personnel in the fundamental principles of construction of flameproof enclosures, **10.5.2** to **10.5.4** bring out some of the important features.

10.5.1.1 Any alteration of a flameproof enclosure is prohibited.

10.5.2 For air-filled apparatus the structural gaps between the joint surfaces and the diametral clearances for operating rods and spindles shall be as small as possible and shall in no case be more than 0·5 mm for a length of flamepath not less than 25 mm along the joint. Where the length of flamepath for a joint is between 13 mm and 25 mm, the structural gap between the joint surfaces shall not exceed 0·4 mm.

For oil-filled apparatus the structural gaps between the joint surfaces and diametral clearance for operating rods and spindles shall in no case be more than 0·15 mm for a length of flamepath not less than 25 mm along the joint.

10.5.3 Diametral clearance of shaft and plain or labyrinth gland for motors and other rotating machinery with a length of flamepath along the joint not less than 25 mm shall not be more than 0·5 mm.

NOTE — The flamepaths and clearances mentioned in **10.5.2** and **10.5.3** are subjected to changes as and when IS : 2148-1962* is revised.

10.5.4 Painting shall, in general, be necessary to preclude rusting and corrosion. Aluminium paint shall, however, not be used, since this may give rise to dangerous frictional sparking on impact.

10.5.5 Great care should be exercised in the handling of parts of flameproof electrical equipment as any damage to them would destroy the flameproofness of the equipment.

10.5.6 Before replacing a cover, the flanges shall be cleaned and lightly greased.

10.5.7 The force used when tightening up bolts, nuts and screws shall not be more than is necessary, to ensure that no appreciable gap exists at the flanges. The heads of set-screws in bottomed holes shall not stand proud of the shroud due to accumulation of dirt in the bottom of the blind hole.

10.5.8 Damaged or missing bolts and set-screws shall be replaced by others of correct diameter, thread, length, type of head and quality of steel.

10.5.9 The flameproof gap is the most important features of any flameproof enclosures and greatest care and attention shall be paid when dismantling and reassembling equipment. Further, no attempt shall be made to insert feelers when the circuit is live.

*Specification for flameproof enclosures of electrical apparatus. (Since revised).

Since the cable sealing box and gland constitute a closure on the terminal box, the flameproofness of the terminal box shall be ensured only when the sealing box is completely filled with compound as intended.

In general, the use of conduits and conduit stopper boxes in coal mines is permissible only for connection to two more pieces of apparatus mounted on the same baseplate, framework or foundation, or in conditions where disturbance of the conduit by relative movement of the parts is not to be expected.

10.5.10 The bearings of switch spindles clearances of shaft glands of the fixed or labyrinth type shall be regularly inspected and lubricated.

10.5.11 Cracked or broken glass windows or well-glasses shall be promptly replaced by fresh glasses complete with retaining rings supplied by the manufacturer.

10.6 Special Precautions for Maintenance of Intrinsically Safe Equipment

10.6.1 Intrinsically safe circuits shall, under no circumstances, come into direct or indirect electrical contact or induction with other circuits. Special care shall be taken when examining wiring inside equipment to ensure that segregation of the circuits exist.

10.6.2 The safety of the circuit is much dependant upon the inductance present and it would not be very easy to check at site the trustworthiness of the safety devices which absorb part of the energy. Any damaged electrical component shall be replaced by identical one obtained from the manufacturer.

APPENDIX A

(*Clauses* 8.5.1 *and* 8.6.3.1)

PERMISSIBLE TYPES OF CABLES (PREFERRED)

Sl No.	Type and Brief Description	Range of Application	Remarks
1	VR insulated and PCP sheathed copper conductored flexible trailing cable to types FT1 to FT6 of IS : 691-1966*	For use with coal cutters and similar portable machines (working voltage not exceeding 650 V to earth)	Individually screened cables (Types FT4, FT5 and FT6) shall be preferred for collectively screened types
2	VR insulated, tough rubber sheathed, galvanized steel strand armoured and overall PCP sheathed copper conductored pliable armoured flexible cable to types P1 to P3 of IS : 691-1966*	For use with transportable machines like conveyors, loaders, etc, (working voltage not exceeding 650 V to earth)	Any one of the types may be used depending upon requirement of the equipment (3, 4 or 5 cores)
3	VR insulated tough rubber sheathed, galvanized steel strand armoured and overall PCP sheathed copper conductored pliable armoured flexible cable to types PC1 and PC2 of IS : 691-1966*	For remove control applications (working voltage not exceeding 250 V to earth)	—
4	Similar type of construction as in Item 3 but to types PL1 and PL2 of IS : 691-1966*	For coal face lighting (working voltage not exceeding 250 V to earth)	—
5	Pliable armoured flexible trailing cable with rubber insulated copper conductor cords, tough rubber sheathing, galvanized steel strand armoured and PCP overall sheathed to types PA1C to PA4 of IS : 1026-1966†	For use in quarries and metalliferous mines (working voltage not exceeding 650 V to earth)	Cables with cradle separator and with canvas reinforcement are preferable to those with a cradle centre and without canvas reinforcement. (Preferred types — PA1C and PA3C)

*Specification for rubber-insulated flexible trailing cables for use in coal mines.

†Specification for flexible trailing cables for use in quarries and metalliferous mines.

Sl No.	Type and Brief Description	Range of Application	Remarks
6	Similar type of construction as in Item 5 but to types 3PA1C to 3PA2 and 6PA1C to 6PA2 of IS : 1026-1966*	For use in quarries and metalliferous mines (working voltage not exceeding 3 300 V and 6 600 V to earth respectively)	Same as for Item 5 (Preferred types — 3PA1C and 6PA1C)
7	Armoured paper insulated lead sheathed cables with double wire armouring with copper conductor cores to IS : 1027-1968*, mass impregnated non-draining type	For all permanent installations in all workings except working districts and development workings	Working voltage to suit type of cable
8	PVC insulated and armoured and PVC sheathed cables to IS : 1554 (Part I)-1964‡	Same as for cables covered by Item 7 but excluding shafts	—
9	Mine telephone cables with rubber or thermo-plastic insulation and armouring	For all permanent installations in all workings except working districts and development workings (not exceeding 250 V to earth)	—
10	Mine signalling cables with rubber or thermoplastic insulation and armouring	do	—
11	Cables for telecommunication system	Permanent installation for telecommunication system (not exceeding 250 volts to earth)	—
12	Flexible cables for miners' cap-lamps to IS : 2593-1964§	For use in miners' safety electric cap-lamps	—
13	Shot firing cables conforming to IS : 5950-1971‖	—	—

*Specification for flexible trailing cables for use in quarries and metalliferous mines.

†Specification for paper-insulated cables for use in mines.

‡Specification for PVC insulated (heavy duty) electric cables: Part I For working voltages up to and including 1 100 volts (*revised*).

§Specification for flexible cables for miners' cap-lamps.

‖Specification for shot firing cables.

BUREAU OF INDIAN STANDARDS

Headquarters:
Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002
Telephones: 323 0131, 323 3375, 323 9402 **Fax** : + 91 11 3234062, 3239399, 3239382
E - **mail** : bisind @ del 2.vsnl.net.in **Internet** : http://wwwdel.vsnl.net.in/bis.org

Central Laboratory :	***Telephone***
Plot No. 20/9, Site IV, Sahibabad Industrial Area, Sahibabad 201010	91-77 00 32
Regional Offices:	
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	323 76 17
*Eastern : 1/14 CIT Scheme VII, V.I.P. Road, Kankurgachi, CALCUTTA 700054	337 86 62
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43
Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113	235 23 15
†Western : Manakalaya, E9, MIDC, Behind Marol Telephone Exchange, Andheri (East), MUMBAI 400093	832 92 95
Branch Offices:	
'Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMEDABAD 380001	550 13 48
‡Peenya Industrial Area, 1st Stage, Bangalore-Tumkur Road, BANGALORE 560058	839 49 55
Commercial-cum-Office Complex, Opp. Dushera Maidan, Arera Colony, Bittan Market, BHOPAL 4620160	72 34 52
62/63, Ganga Nagar, Unit VI, BHUBANESHWAR 751001	40 36 27
Kalai Kathir Building, 670 Avinashi Road, COIMBATORE 641037	21 01 41
Plot No. 43, Sector 16 A, Mathura Road, FARIDABAD 121001	91-28 88 01
Savitri Complex, 116 G.T. Road, GHAZIABAD 201001	91-71 19 98
53/5 Ward No.29, R.G. Barua Road, 5th By-lane, GUWAHATI 781003	56 65 08
5-8-56C, L.N. Gupta Marg, Nampally Station Road, HYDERABAD 500001	320 10 84
E-52, Chitaranjan Marg, C- Scheme, JAIPUR 302001	37 38 79
117/418 B, Sarvodaya Nagar, KANPUR 208005	21 68 76
Seth Bhawan, 2nd Floor, Behind Leela Cinema, Naval Kishore Road, LUCKNOW 226005	21 89 23
NIT Building, Second Floor, Gokulpat Market, NAGPUR 440010	52 51 71
Patliputra Industrial Estate, PATNA 800013	26 28 08
Institution of Engineers (India) Building 1332 Shivaji Nagar, PUNE 411005	32 36 35
'Sahajanand House' 3rd Floor, Bhaktinagar Circle, 80 Feet Road, RAJKOT 360002	26 85 86
T.C No. 14/1421, University P. O. Palayam, THIRUVANANTHAPURAM 695034	32 72 15

*Sales Office is at 5 Chowringhee Approach, P.O. Princep Street, CALCUTTA 700072 — 27 10 85

†Sales Office is at Novelty Chambers, Grant Road, MUMBAI 400007 — 309 65 28

‡Sales Office is at 'F' Block, Unity Building, Narashimaraja Square, BANGALORE 560002 — 222 39 71

Printed at Prabhat Offset Press, New Delhi-2